

DEER WARNING SYSTEM

OPERATING DOCUMENTATION AND SETUP

June 2011



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1. Overview

This document describes the setup and maintenance procedures for the Active Deer Warning System near Marshall, MN. In some cases, it is necessary to refer to the documentation provided by individual device manufacturers for specific procedures. Manuals for these devices have been provided to Mn/DOT District personnel. The detector manual is also included in this document as it requires periodic maintenance checks.

The Deer Warning System consists of two subsystems: detector stations and signs. The detector stations are placed along the roadside at distances of approximately 150 to 400 feet, depending on terrain conditions. Pairs of infrared beams are emitted by the detectors and both must be broken for a detection “event” to occur. When an animal is detected, a communications device connected to the detector receiver broadcasts a unique identifier over a 915 MHz radio network.

The sign subsystems receive the identifier and then search a programmable list stored on another communications device. If the identifier is found, it will then output a voltage to a 12-volt relay which directs power to the LED beacon. The duration of beacon flash and the list of associated detectors for each sign is user-programmable through a software application.

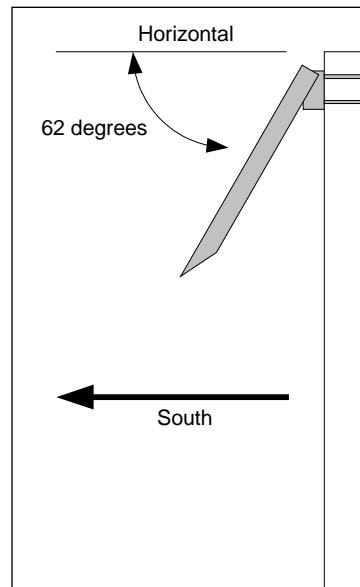
Note: in June 2011, all the system's communication devices (called Wavelogs) were replaced with a version that draws power from the system's large 12-volt battery rather than a battery internal to the Wavelog. These new Wavelogs also added the capability to “soft reset” the device. This reset restarts the device but does not clear its internal memory, so programming remains intact. Push buttons were added to the enclosures that activate the Wavelog's reset feature.

2. System Setup

Solar Panel Orientation

All devices in the system are powered by 12-volt batteries recharged by solar panels. Other than connecting the leads for batteries and panels to the charge controller, the only adjustment to be made is panel orientation.

Panels should always face south to maximize the amount of solar radiation absorbed by the panel. Because of the latitude of the system near Marshall, panels should be angled so that they are perpendicular to the sun's rays when it is at its seasonal low in late December. In Marshall, MN the proper angle is approximately 62 degrees below horizontal. This orientation is shown in Figure 1.



Detectors

Proper alignment of detectors is critical for two reasons. First poorly aligned detectors are more prone to “false positive” activations, which undermine the credibility of the system and (if excessive) may cause failures in other system components. Second, as signal conditions between the detectors deteriorate the system will attempt to compensate by increasing the transmission power. If this occurs during low power-input times (during winter overcast days, for example), the battery reserves may be depleted, resulting in erratic system behavior.

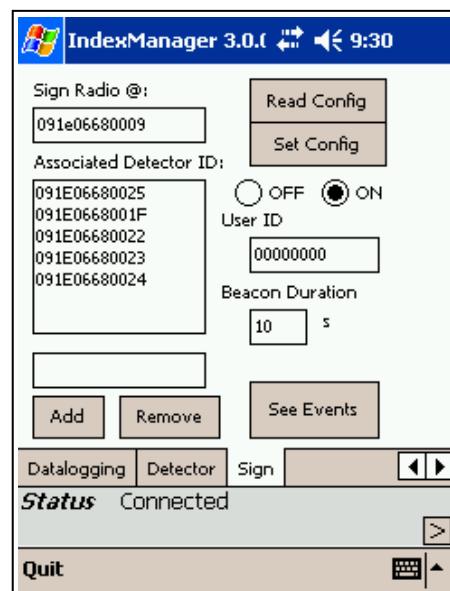
The alignment process for the detectors is described in the device manual provided in Appendix D. The following points should be considered when reviewing this material:

- 1) The process will generally require two people to complete: one at the transmit detector and one at the receiver.
- 2) Since signal strength can only be measured at the receiver site, a method of communication (such as walkie-talkies) should be used by the alignment team.
- 3) Transmitter alignment should be performed first (first upper, then lower beams).
- 4) Although “beam blocking” cut-outs are provided in the manuals to isolate the upper and lower beams for alignment, consider using these as a template to make a cut-out of a more durable material, such as cardboard or foam core. The paper cut-outs tend to tear and have difficulty staying attached to the emitter.
- 5) When securing the covers, DO NOT over tighten the small screw at the bottom. Use a precision-type screwdriver to tighten the screw enough to keep the cover in place. Over tightening will result in stripped screw heads and make servicing more difficult.
- 6) Annual checks should be made of detector alignment.

Sign Programming

Programming of the sign is accomplished through the IndexManager application. This software is designed to run on an HP/Compaq IPAQ or compatible device (not supplied as part of the system). The WavePort Compact Flash card must be inserted into the IPAQ’s CF slot or into the slot on a compatible IPAQ sleeve with an appropriate slot.

To access the sign’s Wavelog, scroll to the “Sign” tab on the bottom of the



IndexManager interface. The sign programming tab is shown in Figure 2.

Input the sign Wavelog's ID into the box at the upper left using the on-screen keyboard (tap the icon at the lower right to access the keyboard). Once you have entered the ID, tap "Read Config" to verify that you can communicate to the device.

To add a detector to the sign's Associated Detector list, enter the ID into the box below the list and tap "Add". Detectors may be removed from the list by selecting them and tapping "Remove". No changes will be written to the Wavelog's memory until "Set Config" is tapped. Once programming changes are made, the "Set Values OK" dialog will appear.

The duration of the sign's flashing is set using the "Beacon Duration" box. Enter the value in seconds into this box using the on-screen keyboard and tap "Set Values" to save the change.

The most recent 100 activations of the sign can be viewed by tapping the "See Events" button. A table will be displayed on-screen with the date and time of the events. This table is recorded in a "first in-first out" fashion, so that the oldest events are overwritten.

NOTE: Due to the low data transmission rates of the Wavelog, retrieving this table may take several minutes.

Although similar controls are presented on the "Detector" Tab, only the "on/off" control is functional in this version of the system. This may be used to prevent detector or sign Wavelogs from accepting inputs or producing outputs.

3. Testing

Power System Checks

Once installed, the power system should be checked for proper operation. To confirm that all components are operating, verify the following:

- 1) With direct sunlight, measure voltage on the solar panel leads. This should be 17 volts or greater
- 2) Measure voltage at the battery leads, this should be 13 volts or greater.
- 3) Measure voltage at the load leads on the charge controller. This should be 12-14 Volts.

Annual checks of battery condition should also be made. Disconnect the battery from the charge controller and connect a battery load tester to the battery terminals. Verify that the battery reads "good" on the tester in the appropriate load range.

Activation Checks

System activation can be checked by interrupting the beam between detector stations. If a comprehensive check of all detectors and signs is to be performed, the following procedure is recommended:

- 1) Position one person at each end of the system
- 2) Access the Wavelog for each of the signs and set its beacon duration to 5 seconds to minimize the time needed between testing each detection zone.
- 3) Interrupt the beam at each detector site
- 4) Observe the operation of each sign
- 5) When complete, reset the beacon duration at each sign to the desired flash duration.

4. Maintenance

Environment

The area between detectors must be kept free of obstructions for the system to operate properly. The primary concern will be grass or other vegetation growth that may interfere with the infrared beams.

The installation area should be monitored on a monthly basis during the growing season. The need for mowing will vary based on weather, vegetation type and other conditions, but mowing will generally be needed every six to eight weeks.

Proper exposure of the solar panels is also important to system operation. Tree growth should be monitored in the area and, where possible, trimmed to maximize the hours of sunlight that the system will receive.

Detector Alignment

Wind induced vibration or other debris impacts may cause detector alignment to “drift” over time, requiring periodic adjustment. While this should not be needed in most cases, annual checks are recommended using the following procedure:

- 1) Remove the outer cover of the detector receiver
- 2) If the signal strength reads “Excellent” with a steady indication, no further action is needed.
- 3) If the reading is other than Excellent or fluctuates, align the detectors using the procedure described in the System Setup section.

Power System

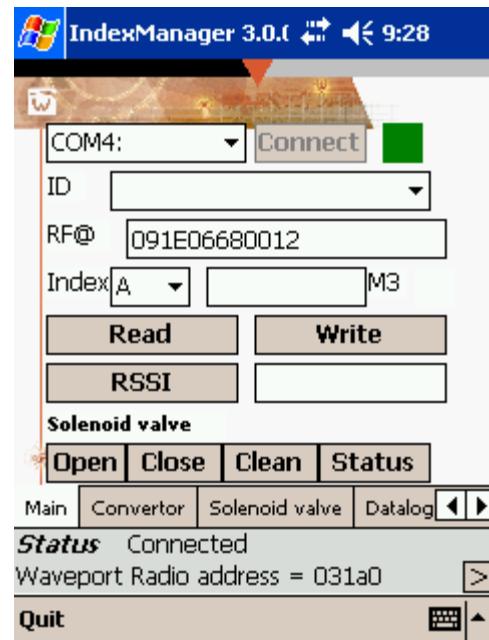
Lifetime expectance of the solar panels and charge controllers is 15 years and neither should require any maintenance. Should the panels become dirty, rinsing with water is all that is required for cleaning.

System battery life will vary with environmental conditions. Typical life for the battery is expected to be three years. However, annual checks should be made using the test procedure described in the System Setup section.

Communications

The communications system is based on the Coronis Wavelog device. Wavelogs are sealed devices and no service other than replacement is possible. Annual checks using the RSSI check on the “Main” tab of Index manager should be made to ensure continued operation.

Using the on-screen keyboard enter the device ID in the “RF@” box. Tap the RSSI button to read the signal strength from the device. This value will typically range from -70 to -109 dB for proper operation.



Reset Button

As noted in the introduction, reset functionality was added in June 2011. There are three situations where the reset button can be used to maintain the system.

- Immediately after replacing the battery and connecting power
- After the system has been dormant for a period of time (non-operational)
- If the PDA cannot connect to the Wavelog.

To use the reset function, press and hold the reset button for five seconds and release. No additional actions are needed, and the Wavelog device will re-boot in roughly ten seconds.

5. Design Drawings and Documentation Appendices

The following three appendices provide detailed system layout, design, programming and detector operation information.

APPENDIX A

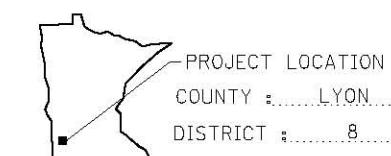
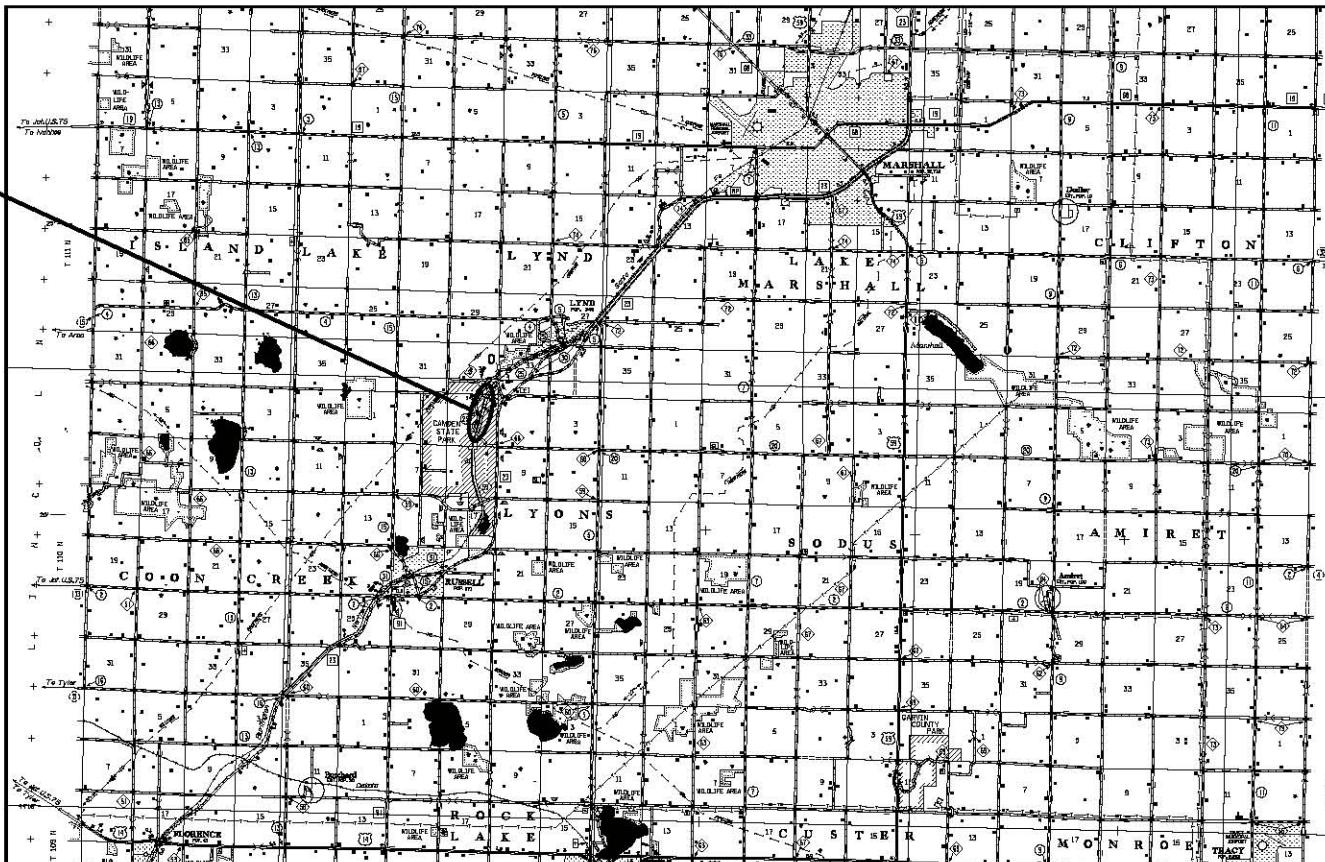
SIGN AND DETECTOR PLAN SHEETS

MINNESOTA DEPARTMENT OF TRANSPORTATION
LYON COUNTY, MINNESOTA
ACTIVE DEER WARNING SYSTEM

CONSTRUCTION PLAN FOR
LOCATED ON TH 23

SIGNALS AND DETECTION SYSTEM

PROJECT LOCATION



FOR PLANS AND UTILITIES SYMBOLS SEE TECHNICAL MANUAL

STATE PROJ. NO. CHARGE IDENTIFIER

.....
.....
.....
.....
.....

I HEREBY CERTIFY THAT THE FINAL FIELD CHANGES, IF ANY, OF THIS PLAN WERE
MADE BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED
PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE _____
DATE _____ LIC. NO. _____ PRINT NAME _____

FED. PROJ. NO. _____

GOVERNING SPECIFICATIONS

THE 2005 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION
"STANDARD SPECIFICATIONS FOR CONSTRUCTION", SHALL GOVERN.
ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE INSTALLED IN ACCORDANCE
TO THE 'MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES' (MN MUTCD)
AND PART VI, 'FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS'.

INDEX

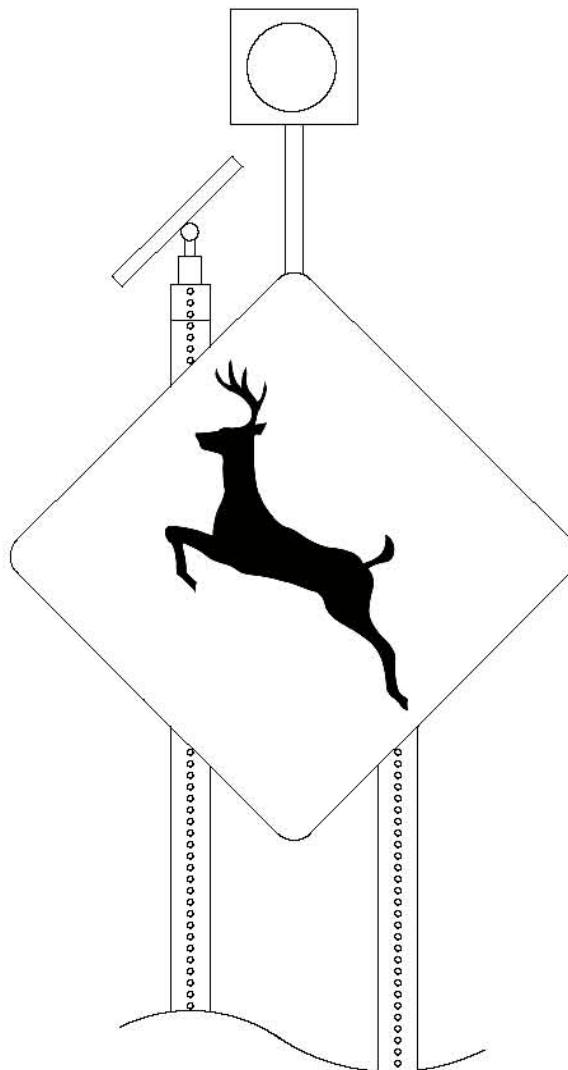
SHEET NO.	SHEET DESCRIPTION
1	TITLE SHEET
2-4	MISCELLANEOUS DETAILS
5	CONSTRUCTION PLAN

THIS PLAN CONTAINS 5 SHEETS

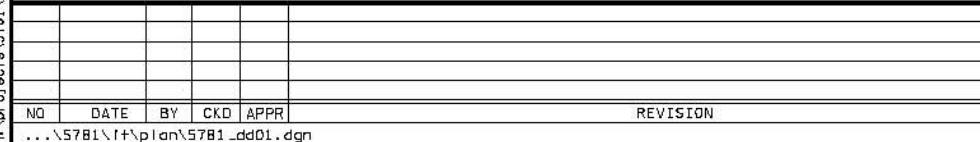
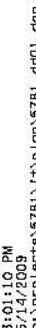
SRF CONSULTING GROUP, INC.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR
UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED
PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE _____
DATE 2/20/2007 LIC. NO. 22046 PRINT NAME BRIAN L. SCOTT



FRONT VIEW



STATE AID PROJ
X
X
STATE PROJECT
X
COUNTY PROJECT
X
CITY PROJECT

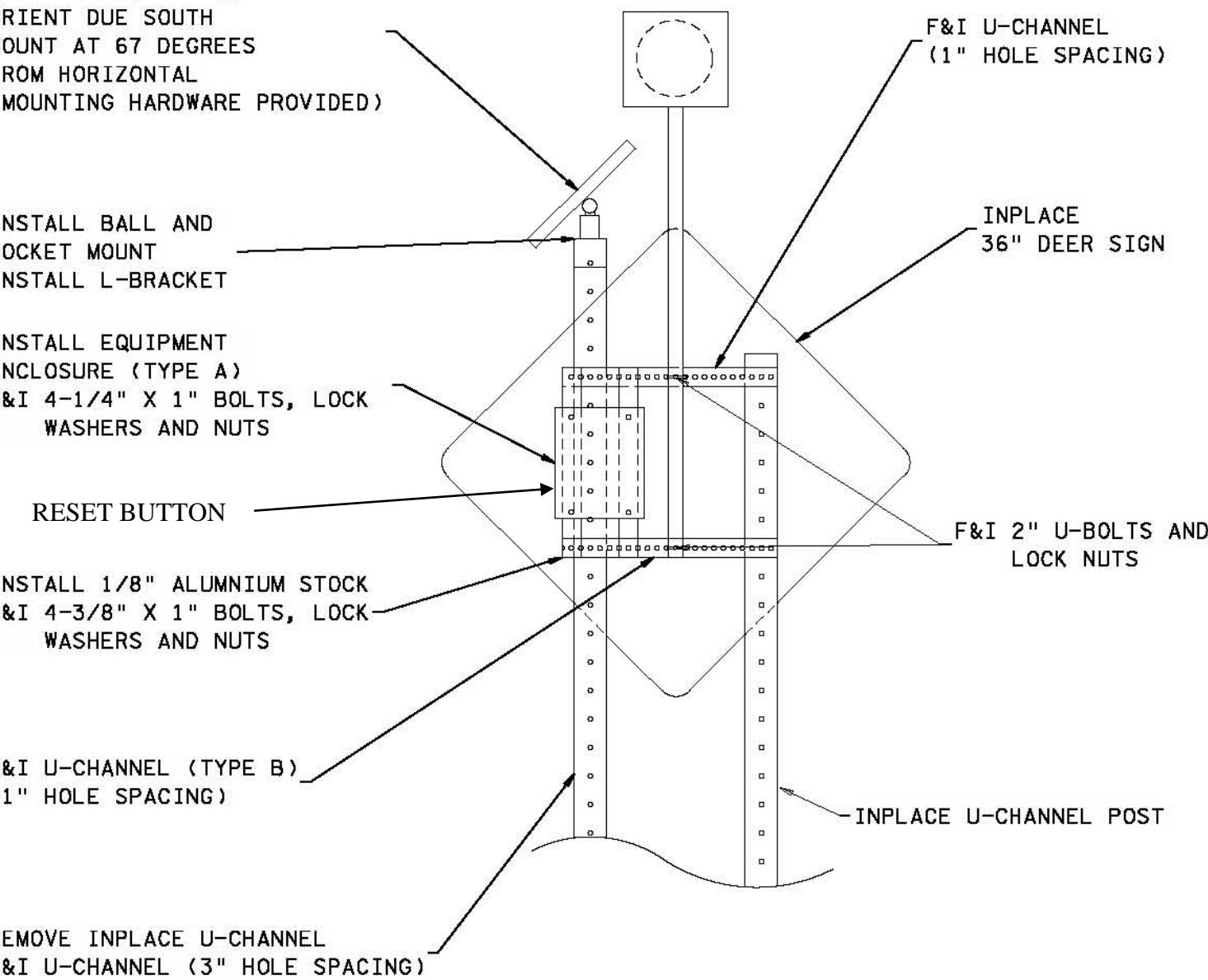
ECT NO.	DRAWN S. PETER
NO.	DESIGNE S. PETER
T NO.	CHECKE M. GALLA
NO. X	COMM. NO.

Y
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BY
EN
BY
HER

SRF CONSULTING
GROUP, INC.

MINNESOTA DEPT. OF TRANSPORTATION
SIGN DETAIL
ACTIVE DEER WARNING SYSTEM
FRONT AND REAR DETAILS

SHEET
2
OF
5



REAR VIEW - EQUIPMENT INSTALLATION

INSTALL 1 1/2" NIPPLE
F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT WITH
1-4/C #18 INSIDE NIPPLE FROM
BEACON TO EQUIPMENT
ENCLOSURE

F&I STAINLESS STEEL
PIPE CLAMP, CLAMP
CONDUIT TO U-CHANNEL

F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT
WITH 1-4/C #18

CONDUIT RUNS BETWEEN
ENCLOSURE AND SIGN

RESET BUTTON

F&I 2-LIQUIDTIGHT FITTINGS
2-REDUCING WASHERS
(3/4" X 1/2")

F&I STAINLESS STEEL
PIPE CLAMP, CLAMP
CONDUIT TO U-CHANNEL

F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT
WITH 1-4/C #18

REAR VIEW - CONDUIT ROUTING

F&I STAINLESS STEEL
PIPE CLAMP, CLAMP
CONDUIT TO U-CHANNEL

INSTALL 1 1/2" NIPPLE
F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT WITH
1-4/C #18 INSIDE NIPPLE FROM
BEACON TO EQUIPMENT
ENCLOSURE

F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT
WITH 1-4/C #18 CONDUIT
SHALL RUN BETWEEN SIGN
AND EQUIPMENT ENCLOSURE

F&I STAINLESS STEEL
PIPE CLAMP, CLAMP
CONDUIT TO U-CHANNEL

INPLACE DEER WARNING SIGN

INSTALL EQUIPMENT ENCLOSURE
(TYPE A)
F&I 2-LIQUIDTIGHT FITTINGS
2-REDUCING WASHERS
(3/4" X 1/2")

SIDE VIEW - CONDUIT ROUTING

F&I 1/4" X 1" BOLT,
LOCK WASHER AND NUT

INSTALL BALL AND
SOCKET MOUNT

F&I 2-1/4" X 1" PAN
HEAD SCREWS,
LOCK WASHERS
AND NUTS

F&I 1/4" X 1" BOLT,
LOCK WASHER AND NUT

F&I U-CHANNEL

L-BRACKET

INSTALL WAVELOG AS DIRECTED BY THE ENGINEER
(BAND TO POLE WITH 1/2" STAINLESS STEEL
BANDING)
F&I 1/2" LIQUIDTIGHT FLEXIBLE NON-METALLIC
CONDUIT FROM SOLAR PANEL TO WAVELOG

INSTALL SOLAR PANEL AND MOUNT (TYPE B)
ORIENT DUE SOUTH
MOUNT AT 67 DEGREES FROM HORIZONTAL
F&I 2-1/2" CONDUIT FITTINGS (3/4" KNOCKOUT)

REMOVE EXISTING CONDUIT

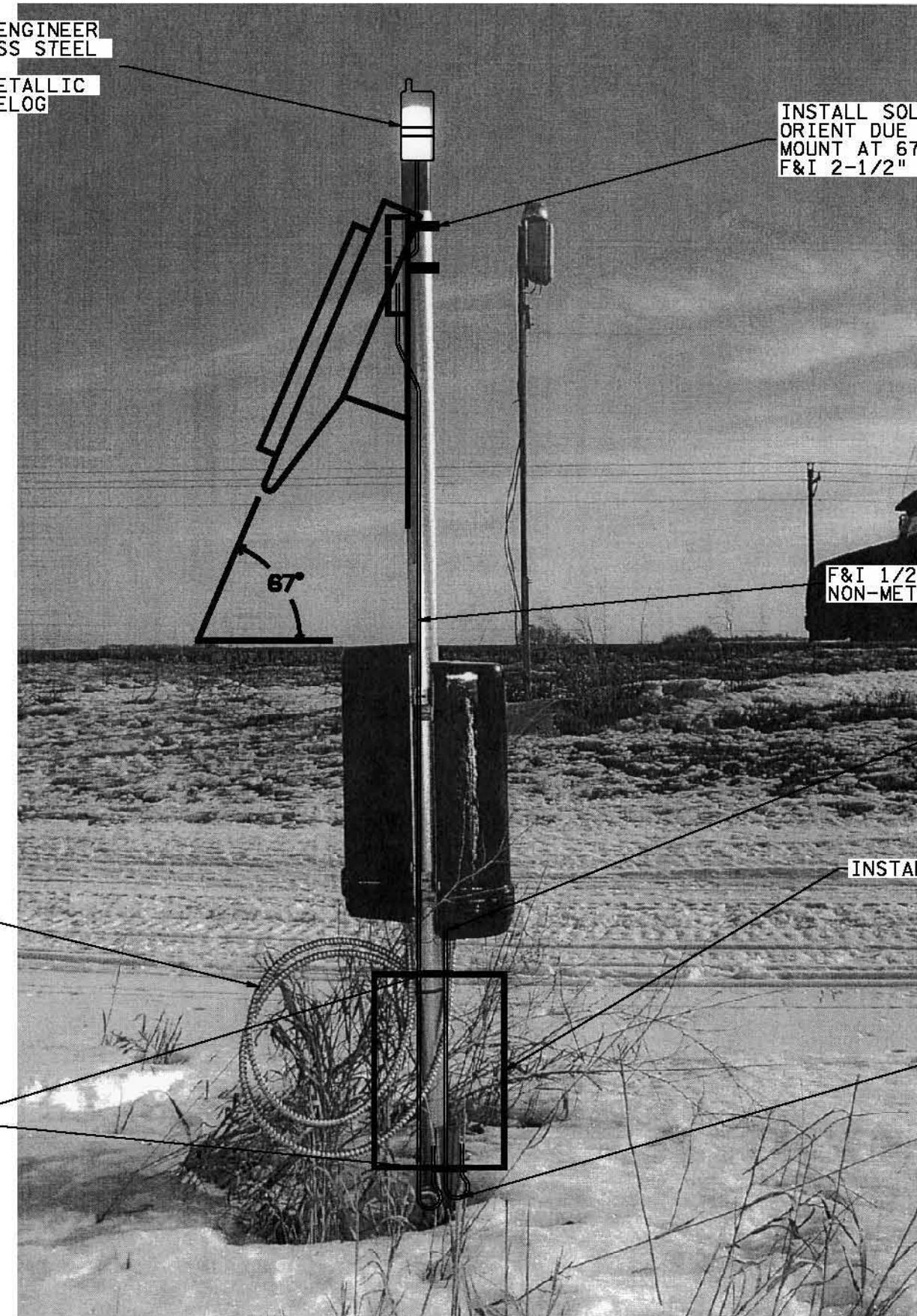
F&I 1 1/2" U-BOLTS

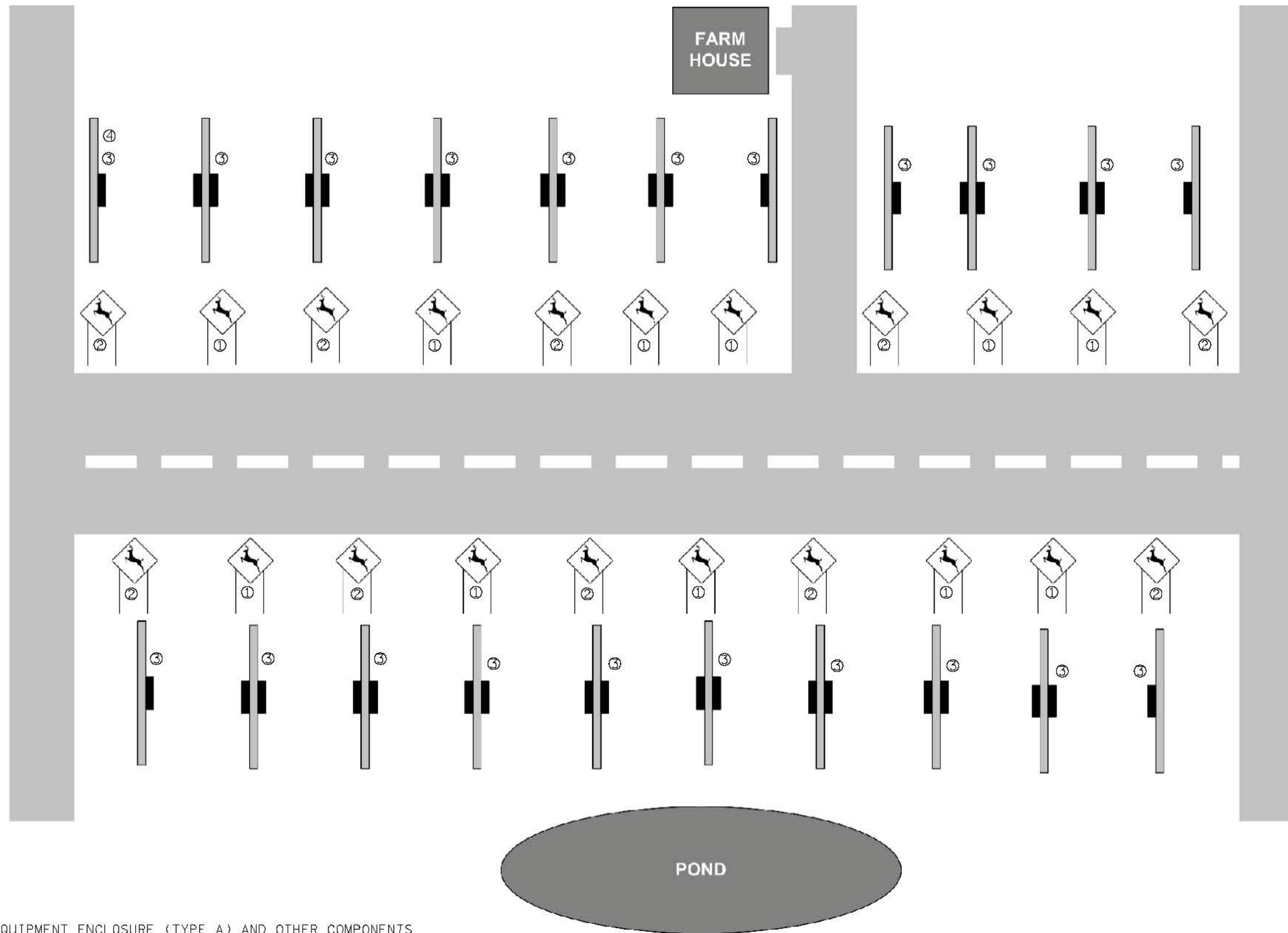
F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT WITH 1-4/C #18

F&I 1/2" LIQUIDTIGHT FLEXIBLE
NON-METALLIC CONDUIT WITH
2-4/C #18 FROM ENCLOSURE TO
DETECTOR

INSTALL EQUIPMENT ENCLOSURE (TYPE B)

F&I 2-1/2" LIQUIDTIGHT FITTINGS
2-REDUCING WASHERS (3/4" x 1/2")





① SALVAGE SIGN
② INSTALL SOLAR PANEL (TYPE A), EQUIPMENT ENCLOSURE (TYPE A) AND OTHER COMPONENTS
③ INSTALL SOLAR PANEL (TYPE B), EQUIPMENT ENCLOSURE (TYPE B) AND OTHER COMPONENTS
④ F&I DETECTOR POLE

NO	DATE	BY	CKD	APPR
REVISION				

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.
Print Name: BRIAN L. SCOTT
Date _____ License # 22045

STATE AID PROJECT NO. X
DRAWN BY S. PETERSEN
STATE PROJECT NO. X
COUNTY PROJECT NO. X
CITY PROJECT NO. X

DESIGNED BY S. PETERSEN
CHECKED BY M. GALLAGHER
COMM. NO. 5781

SRF CONSULTING GROUP, INC.

MINNESOTA DEPT. OF TRANSPORTATION
SCHEMATIC PLAN VIEW OF DETECTION SITE
ACTIVE DEER WARNING SYSTEM

SHEET 5 OF 5

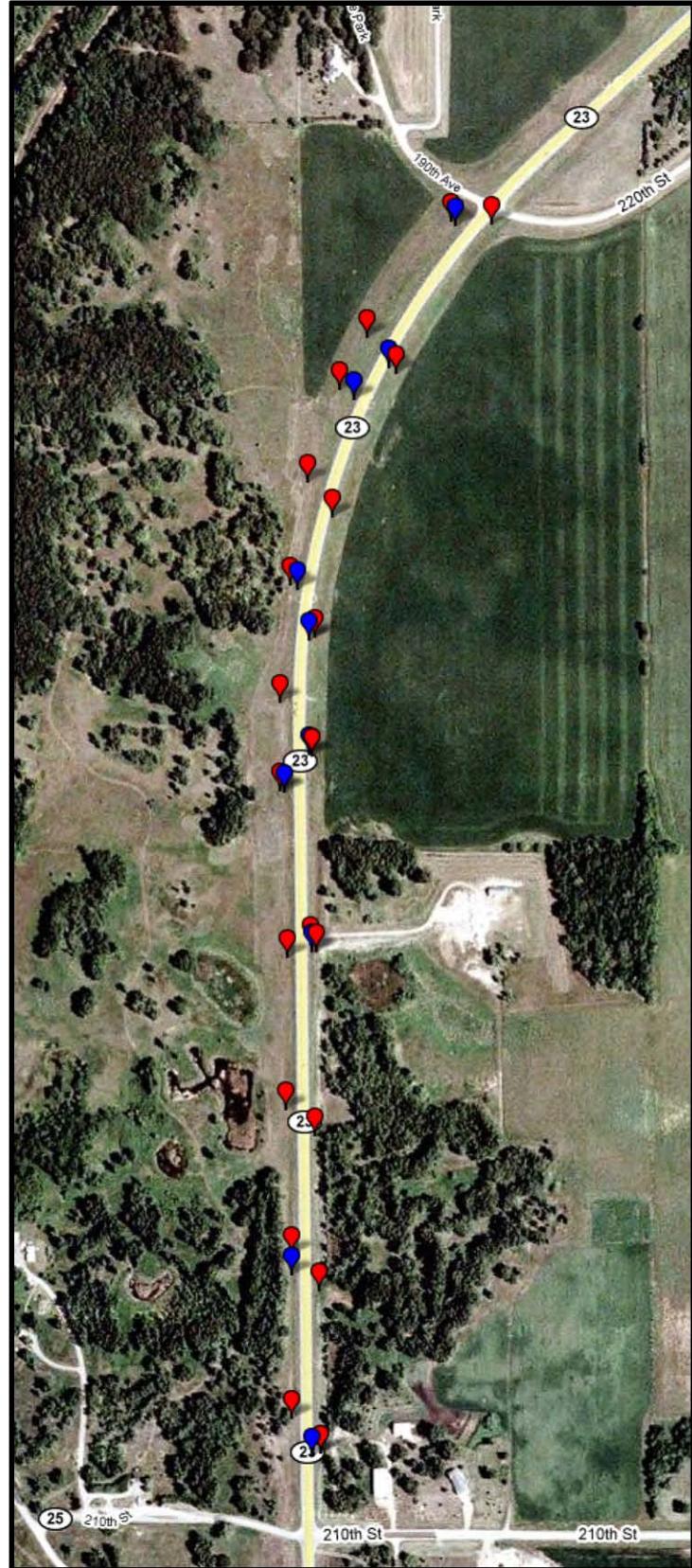
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APPENDIX B

SYSTEM PHYSICAL LOCATIONS

Signs Shown in **BLUE**

Detectors Shown in **RED**



Marshall Area Deer Warning System Layout

Marshall, MN

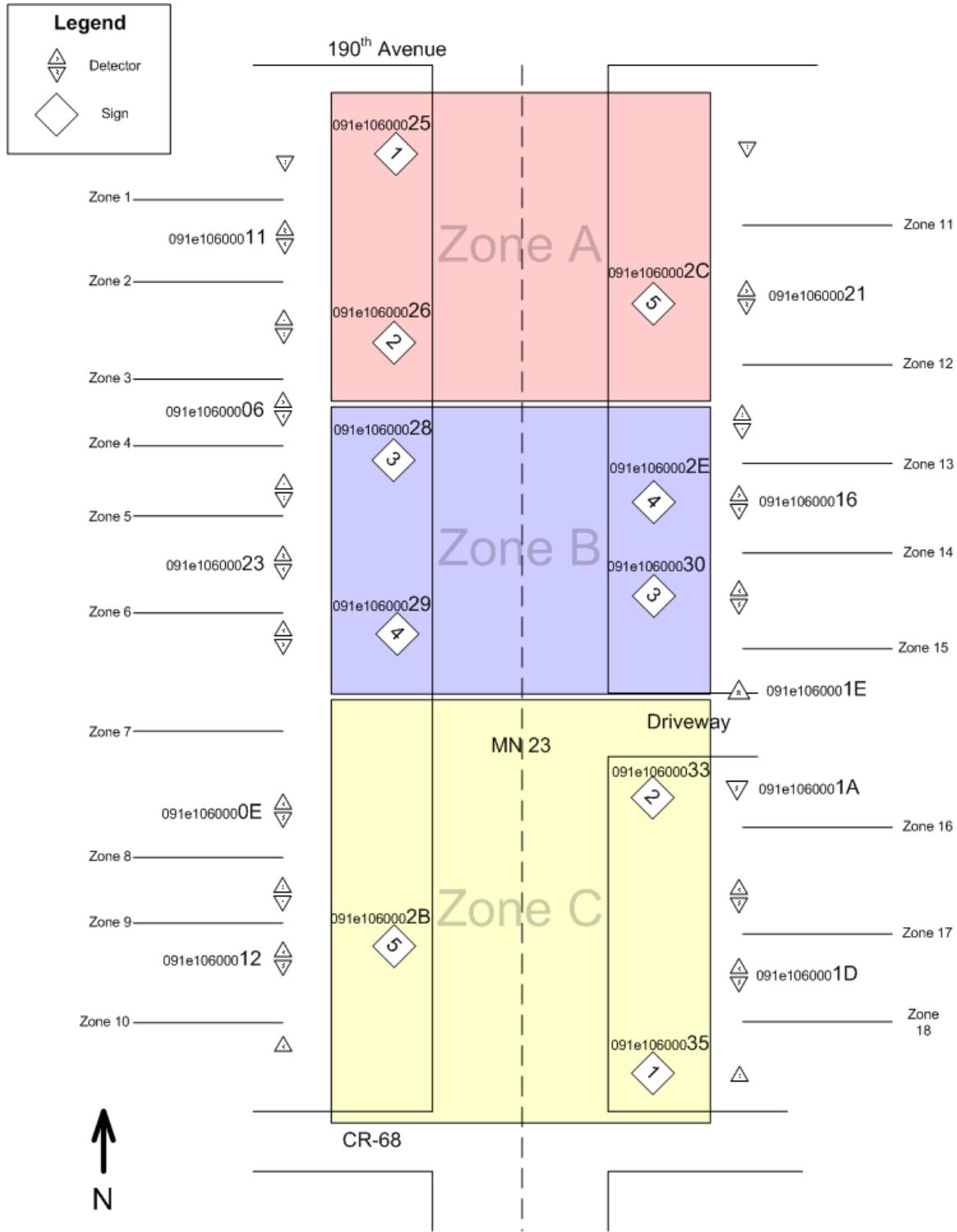
APPENDIX C

SIGN PROGRAMMING KEY

Marshall Active Deer Warning System
Wavelog Addresses
June 1, 2011

Sign 1 SB	Sign 2 SB	Sign 3 SB	Sign 4 SB	Sign 5 SB
091E10600025	091E10600026	091E10600028	091E10600029	091E1060002B
Zone A	Zone A	Zone B	Zone B	Zone C
091E10600011	091E10600011	091E10600006	091E10600006	091E10600023
091E10600006	091E10600006	091E10600023	091E10600023	091E1060000E
091E10600023	091E10600023	091E1060000E	091E1060000E	091E10600012
091E10600021	091E10600021	091E10600012	091E10600012	091E10600016
091E10600016	091E10600016	091E10600016	091E10600016	091E1060001E
		091E1060001E	091E1060001E	091E1060001A
		091E1060001A	091E1060001A	091E1060001D
		091E10600021	091E10600021	

Sign 1 NB	Sign 2 NB	Sign 3 NB	Sign 4 NB	Sign 5 NB
091E10600035	091E10600033	091E10600030	091E1060002E	091E1060002C
Zone C	Zone C	Zone B	Zone B	Zone A
091E10600023	091E10600023	091E10600006	091E10600006	091E10600011
091E1060000E	091E1060000E	091E10600023	091E10600023	091E10600006
091E10600012	091E10600012	091E1060000E	091E1060000E	091E10600023
091E10600016	091E10600016	091E10600012	091E10600012	091E10600021
091E1060001E	091E1060001E	091E10600016	091E10600016	091E10600016
091E1060001A	091E1060001A	091E1060001E	091E1060001E	
091E1060001D	091E1060001D	091E1060001A	091E1060001A	
		091E10600021	091E10600021	



Active Deer Warning System Layout June 2011

APPENDIX D

DETECTOR USER MANUAL

PHOTOELECTRIC DETECTOR

AX-250PLUS, AX-500PLUS, AX-350MK II, AX-650MK II

Please read instructions completely before beginning installation.

Photoelectric detectors detect intruders when both the upper and lower invisible infrared beams are simultaneously broken.

Maximum detection range between Transmitter and Receiver for the AX-250PLUS is 250ft. (75m), the AX-500PLUS is 500ft. (150m) and for the AX-350 MK II is 350ft. (100m), the AX-650MK II is 650ft. (200m)

FEATURES

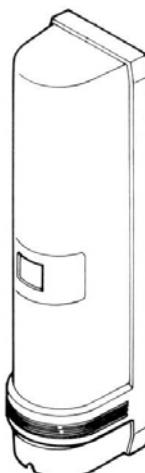
- Beam interruption time adjustment
- Anti-Frost Structure
- Alignment level monitor jack
- Form C relay
- Tamper
- Option
- UL Listed
- : This function allows you to select the suitable beam interruption time for any environment.
- : Prevents fog and condensation from blocking the beams.
- : Can easily obtain maximum optical alignment by checking the voltage from this jack.
- : Form C relay for more applications.
- : N.C., Opens when cover is removed.
- : Heating unit (HU-1), Back cover (BC-1) AX-Beam Tower (AX-BT)

AX-350MK II, AX-650MK II ONLY

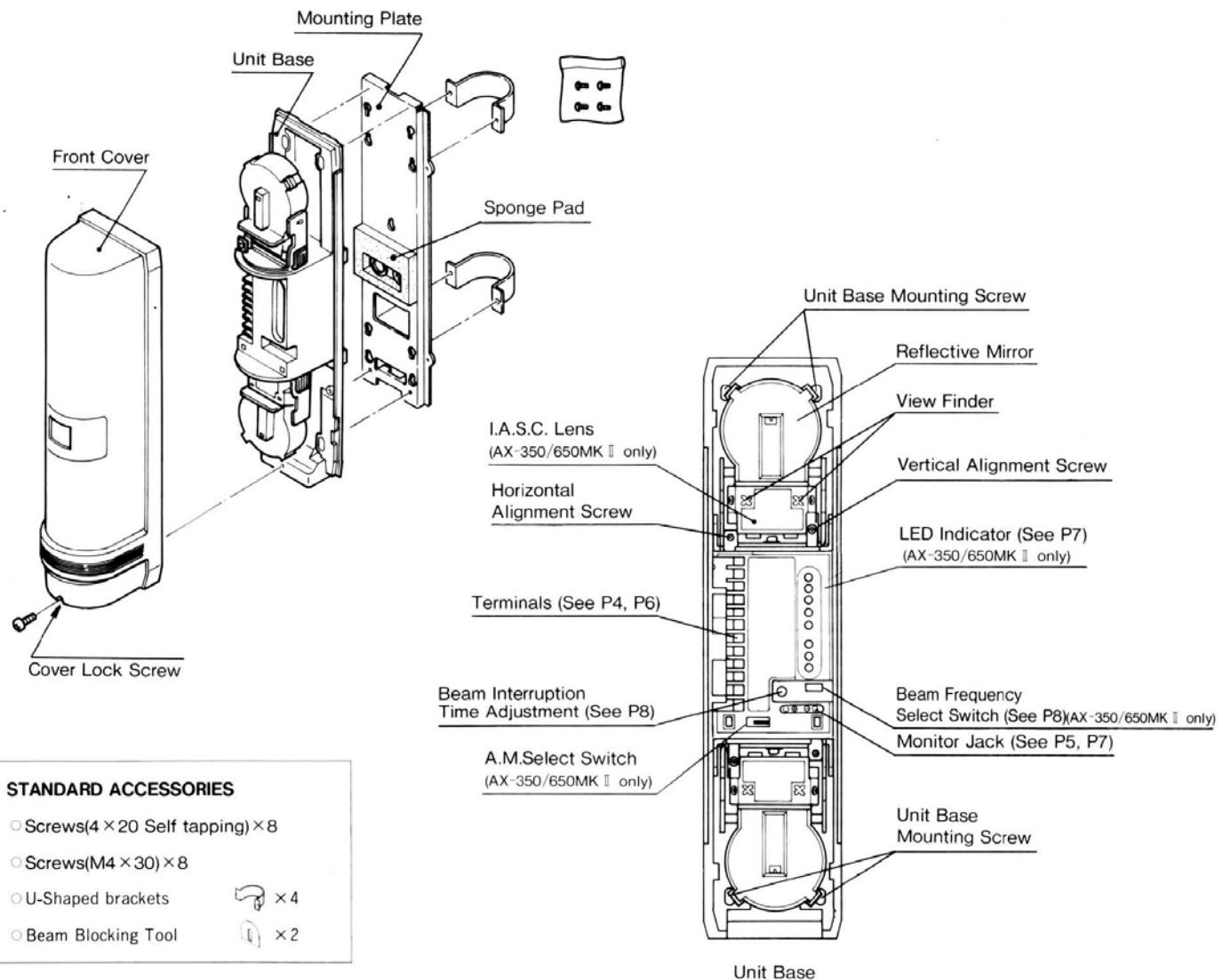
- LED indicator for fine beam alignment level
- Selectable beam frequencies
- Re-Transmit Circuit
- D.Q.Circuit (Environmental Disqualification)
- Alarm Memory
- : The optical alignment level can be checked at both the Receiver and Transmitter. One man beam alignment is easily achieved.
- : Crosstalk is eliminated with 4, channel selectable, beam frequencies. Used when stacking beams or for long range applications.
- : The advantage of this method is the elimination of wiring, from a detector or switch, back to the control panel.
- : The environmental compensation circuit is designed to eliminate false alarms caused by snow, fog, heavy rain, ice and misalignment.

CONTENTS

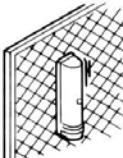
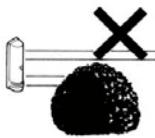
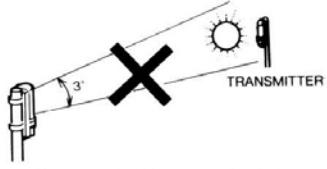
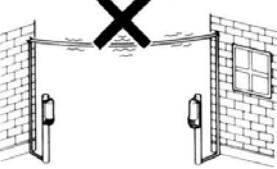
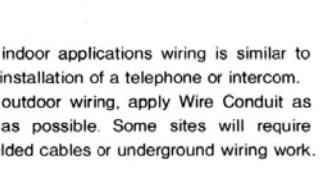
1. PARTS IDENTIFICATION	P2	6. BEAM INTERRUPTION	P8
2. INSTALLATION HINTS	P2	TIME ADJUSTMENT	P8
3. INSTALLATION METHOD	P3	7. AX-350/650MK II	
4. AX-250/500PLUS		7-1. SELECTABLE BEAM FREQUENCIES	P8
4-1. TERMINAL	P4	7-2. ALARM MEMORY	P8
4-2. WIRING	P4	7-3. DQ CIRCUIT	P9
4-3. OPTICAL ALIGNMENT	P5	7-4. RE-TRANSMITTING CIRCUIT	P9
5. AX-350/650MK II		8. SPECIFICATIONS	P10
5-1. TERMINAL	P6	9. DIMENSIONS	P10
5-2. WIRING	P6	10. TROUBLE SHOOTING	
5-3. OPTICAL ALIGNMENT	P7	CHECK SHEET	P11, P12



1. PARTS IDENTIFICATION



2. INSTALLATION HINTS

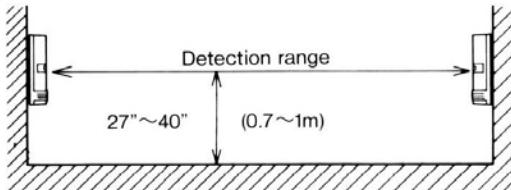
- 1**  **×**
Mount unit only on a solid surface.
- 2**  **×**
Do not install the unit where falling leaves or seasonal growth of branches will block the beam.
- 3**  **×**
Prevent direct sunlight from entering into internal optics.
- 4**  **×**
The mounting pole should have a solid footing with little movement at the top of the pole.
- 5**  **×**
Avoid aerial wiring.
- 6** 
 - For indoor applications wiring is similar to the installation of a telephone or intercom.
 - For outdoor wiring, apply Wire Conduit as far as possible. Some sites will require shielded cables or underground wiring work.

3. INSTALLATION METHOD

a. General

1

Detection range and installation height.

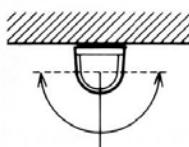


Maximum distances between Receiver and Transmitter are listed below.
 AX-250PLUS = 250ft (75m) Max
 AX-500PLUS = 500ft (150m) Max
 AX-350MK II = 350ft (100m) Max
 AX-650MK II = 650ft (200m) Max
 and the installation height should be at 27"~40".(0.7~1m)

2

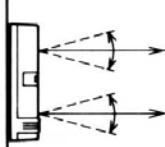
Alignment angle

Horizontally



180° ($\pm 90^\circ$)

Vertically



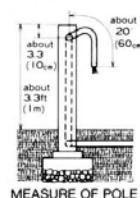
20° ($\pm 10^\circ$)

3

Pole mounting

* Pole size should be as follows : 1 3/8"~1 7/8" O.D ($\phi 34\sim\phi 48mm$)
 (Standard U.S. 1 1/4" or 1 1/2" pipe.)

* The length of the wiring cable out of the pole should be within 20 inches (60cm).

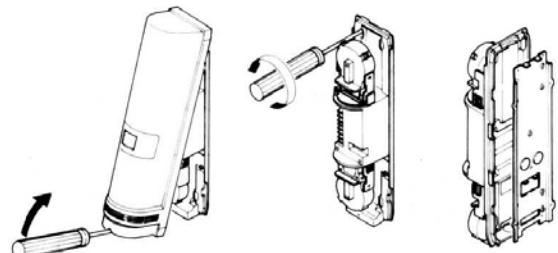


MEASURE OF POLE

* Face transmitter and receiver towards each other when pole mounting.

b. Installation Method

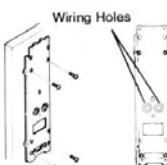
1



Loosen the cover lock screw and remove the front cover. And loosen the unit base mounting screw and remove mounting plate by sliding it down against the unit base.

2

Wall mounting



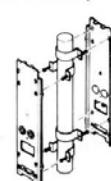
Pull out the wire through the wiring hole on the mounting plate and attach the plate to the wall with the screw.

Pole mounting



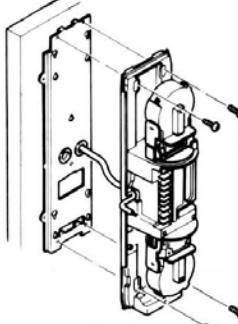
Place U-Shape brackets at the top of the pole. And pull out the wire through the wiring hole of the mounting plate, attach the mounting plate to the U-Shape bracket with screw.

Two unit installation (back to back)



Fix two U-shape brackets in layers on a pole, two units can be installed back to back on a pole at the same height.

3

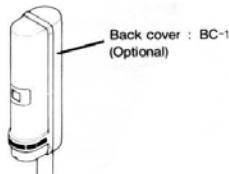


* After checking optical alignment and operation check (See Sec.4-3.5-3 OPTICAL ALIGNMENT), replace the cover, and fasten the cover lock screw tightly.

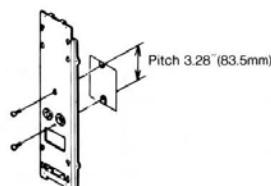
* Connect wire to the terminals (See Sec. 4-1,5-1 "Terminal").

NOTE

●Pole Mount Back Cover

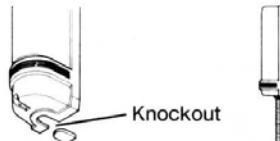
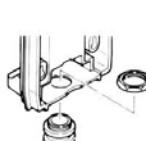


●Electric Box Mounting



For connections to single gang electric boxes, follow instructions for wall mounting.

●Conduit Installation

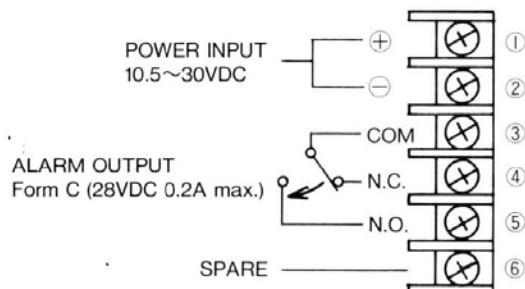


Conduit can be installed directly into the bottom of the unit by removing the knockout on the bottom of the cover.

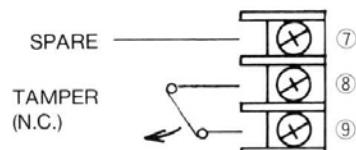
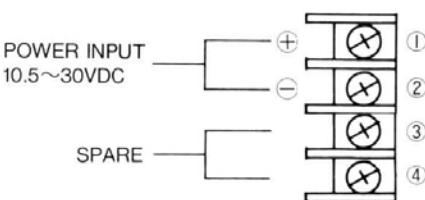
4. AX-250/500PLUS

4-1. TERMINAL

Receiver



Transmitter



Wiring Distance

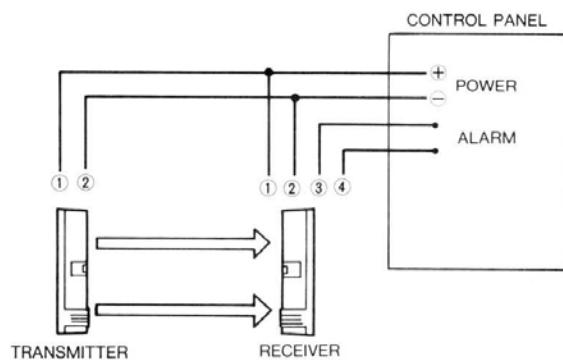
- When using two or more units on one wire, the maximum length is obtained by dividing the wire length listed below by the number of units used.
- Power wires should not exceed the following length.

MODEL	AX-250/500 PLUS	
WIRE SIZE	12V DC	24V DC
AWG22(0.33mm ²)	1300' (400m)	7500'(2300m)
AWG20(0.52mm ²)	2000' (600m)	12000'(3600m)
AWG18(0.83mm ²)	3300' (1000m)	19000'(5800m)
AWG16(1.31mm ²)	5000' (1500m)	30000'(9200m)

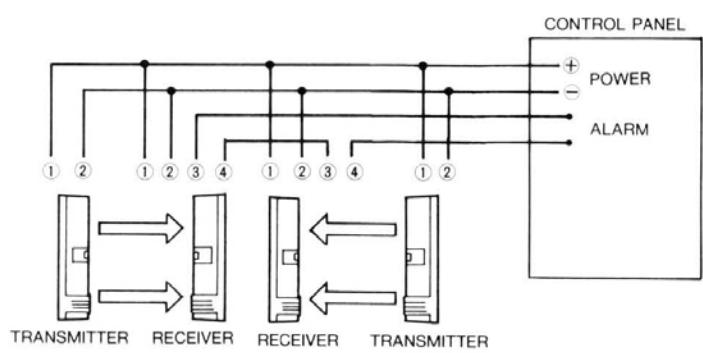
UL requires AX-250PLUS/500PLUS to be connected to a UL listed power supply capable of providing a nominal input of 12VDC,(10.5~30VDC) 50mA and battery standby time of 4 hours.

4-2. WIRING

1 Set



2 Sets in the line

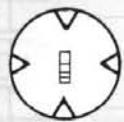


4-3. OPTICAL ALIGNMENT

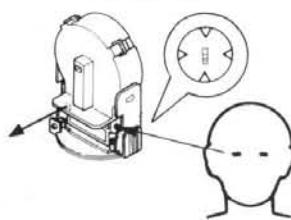
When using two or more units on wire, the maximum length is obtained by dividing the maximum wire length listed below of units used. Power wires should not exceed the following lengths.

STEP1

Rough alignment by view finder

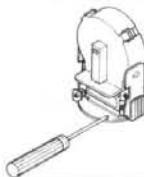


Looking through the view finder, locate the other detector in the center of the sights by adjusting vertically and horizontally.



Looking through the view finder, locate the other detector in the center of the sights by adjusting vertically and horizontally.

Vertical Adjustment



Horizontal Adjustment



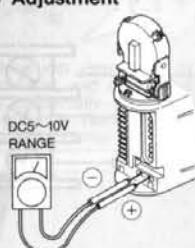
Course Adjustment



Fine Horizontal Adjustment

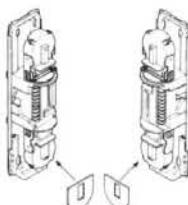
STEP2

Upper Mirror Fine Adjustment



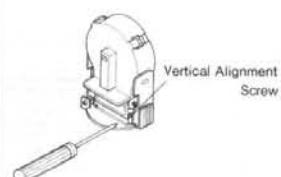
Connect the volt-meter to monitor jack input on Receiver's (+) and (-), then fine tune optical alignment.

Adjust the optical alignment for Transmitter and Receiver one at a time.



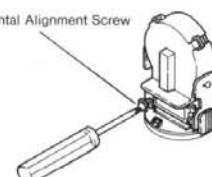
Put the attached "Beam Blocking Tool" on the lower mirror of both the Transmitter and the Receiver.

① Vertical Adjustment



Adjust the vertical alignment screw to obtain the maximum voltage from the monitor jack.

② Horizontal Adjustment

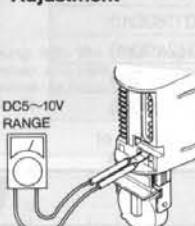


Adjust the horizontal alignment screw to obtain the maximum voltage from the monitor jack.

After the vertical and horizontal adjustment are made, recheck the voltage from monitor jack is over 5.0V. If not, adjust the optical alignment again.

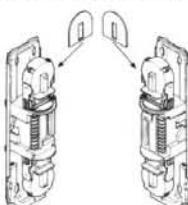
STEP3

Lower Mirror Fine Adjustment



Check the voltage using the monitor jack and make any fine adjustments the lower mirror.

Secondly, adjust the lower mirrors.



After the final adjustment are made on the upper mirrors, carefully without moving mirror remove "Beam Blocking Tool" from the lower mirrors and place them on the upper mirrors of both the Transmitter and Receiver.

Be careful when removing the "Beam Blocking Tool" from the mirror - Don't move mirrors.

SENSITIVITY CHART

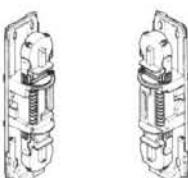
ALIGNMENT level	Realign	Fair	GOOD	EXCELLENT
MONITOR JACK OUTPUT	0V	2.0V	3.5V	5.0V

Optical Alignment for Indoor Use

Obtain maximum voltage from the monitor jack, at least **more than 2.2V**

STEP4

Final checking after removing the "Beam Blocking Tool" from the mirror.



Carefully remove the "Beam Blocking Tool" from the upper mirror of both Transmitter and Receiver also check the voltage from the monitor jack again.

Then check again that the voltage from monitor jack is more than about 5.0V. If not, adjust the optical alignment again.

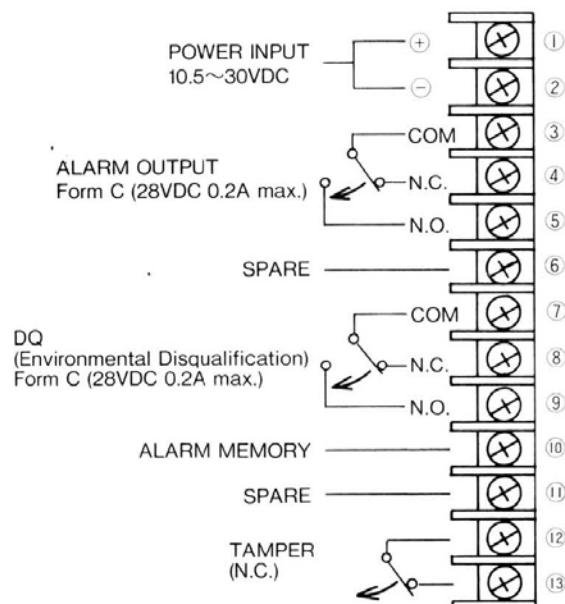
Confirmation of Action

- Check that the operation indicator ("ALARM CONDITION" LED) light is OFF.
- If the indicator light is ON even though the beams are not blocked, re-adjust the optical alignment and check wiring. (See Sec.4-3)
- After alignment is achieved and the units work properly, conduct a walk test at a minimum of three points.
 - In front of the Transmitter.
 - In front of the Receiver.
 - At the middle point between Transmitter and Receiver.

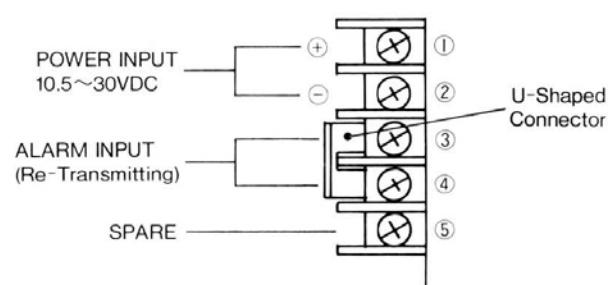
5. AX-350/650MK II

5-1. TERMINAL

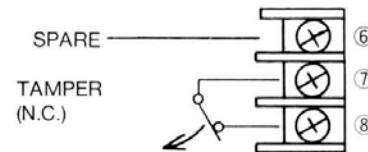
Receiver



Transmitter



CAUTION: Make sure to connect the jumper (U-shaped connector), when not using the retransmitting circuit. If the jumper is not connected, the Transmitter will not transmit beam (Alarm condition).



Wiring Distance

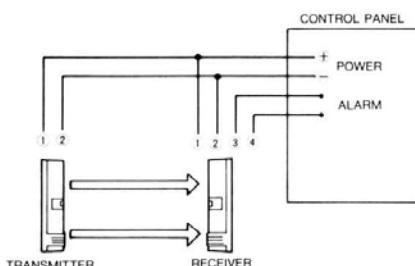
- When using two or more units on one wire, the maximum length is obtained by dividing the wire length listed below by the number of units used.
- Power wires should not exceed the following length.

MODEL	AX-350/650MK II	
WIRE SIZE	12V DC	24V DC
AWG22(0.33mm ²)	650'(200m)	5200'(1600m)
AWG20(0.52mm ²)	980'(300m)	7800'(2400m)
AWG18(0.83mm ²)	1640'(500m)	12000'(3800m)
AWG16(1.31mm ²)	2600'(800m)	20000'(6200m)

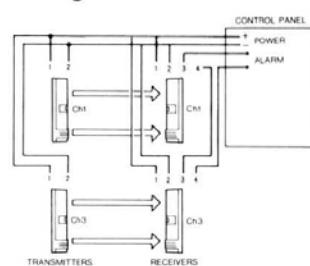
UL requires AX-350MK-II/650MK-II to be connected to a UL listed power supply capable of providing a nominal input of 12VDC,(10.5~30VDC) 75mA and battery standby time of 4 hours.

5-2. WIRING

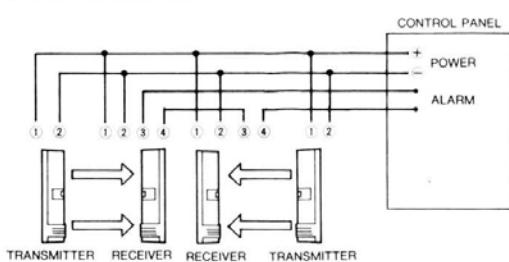
1 Set



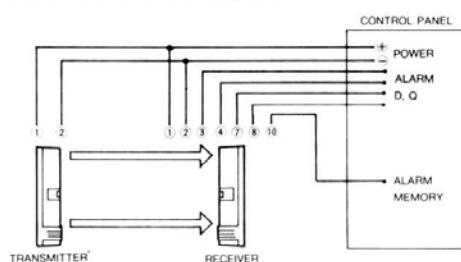
2 Sets Stacking



2 Sets in the line



DQ and ALARM MEMORY



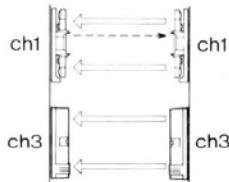
5-3.OPTICAL ALIGNMENT

When using two or more units on wire, the maximum length is obtained by dividing the maximum wire length listed below of units used. Power wires should not exceed the following lengths.

STEP1

Beam Frequencies Selection

Select the beam frequencies switch.



Match the frequency settings. (See Sec.7-1 SELECTABLE BEAM FREQUENCIES.)

IMPORTANT: Always align, upper mirrors first.

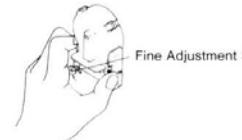
When stacking beams or installing more than one set in the same area, make sure to put the front covers on all of the detectors, except for the one being aligned. (The cover automatically stops optical transmissions of the alignment level) this will prevent the alignment level transmission from nearby units from interfering with the unit being aligned.

STEP2

Horizontal & Vertical Adjustment

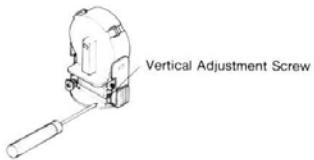


Looking into view finder of the Transmitter, and adjustment the lens horizontally and vertically, so that the Receiver can be seen in the center of the sight.



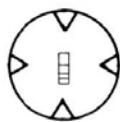
Turn mirror base by hand to obtain the highest alignment level. Make fine adjustment by turning "Fine Adjustment Screw".

② VERTICAL ADJUSTMENT



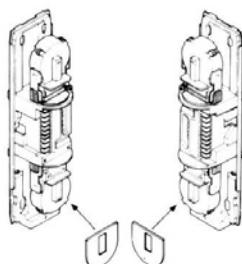
Turn vertical adjustment screw to get highest level

STEP3



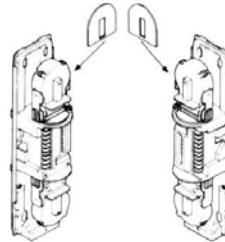
Looking into the view finder of Receiver and make fine adjustments horizontally and vertically.

① ADJUST THE UPPER MIRROR



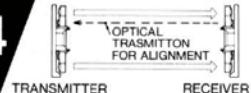
Attach the "Beam Blocking Tool" to the lower mirror on both the transmitter and receiver. Adjust the upper mirror. "Excel" reading on the LED indicator is sufficient.

② ADJUST THE LOWER MIRROR



After the final adjustments are made on the upper mirrors, carefully (do not move mirror) remove the shielding tools from the lower mirrors and place them on the upper mirrors of both the transmitter and receiver. Make the horizontal and vertical adjustments to the lower mirrors. "Excel" reading on the indicator is sufficient.

STEP4



The alignment status of the Receiver is optically transferred to the Transmitter. The Transmitter has the same alignment level indicator as the Receiver, this feature makes one man alignment easy.



The alignment level indicators have 5 LEDs, each LED represents the level of alignment, ranging from poor to excellent (See illus.) Each LED will indicate 3 steps of alignment, slow flicker = okay, fast flicker = better, continuously on = best. Providing 15 graduated stages.



TRANSMITTER CONDITION LED
ON: TRANSMITTING BEAM
OFF: RETRANSMITTING CIRCUIT
IS OPERATING, OR POWER IS
NOT SUPPLIED.



TRANSMITTER

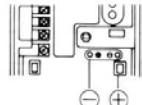
STEP5

Checking From The Monitor Jack

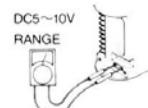


After adjusting with the LED indicators, check the voltage at the monitor jack output using your meter. This will insure proper beam alignment.

Confirm the beam alignment level by setting your volt-meter to the 5~10V DC range, cover either the upper or lower beam and compare the voltage reading with the following chart.



Connect the volt-meter probes (+) to monitor jack (+), and volt-meter probes (-) to monitor jack (-).



Set the volt-meter range to 5~10 VDC.

Check the alignment levels of the upper and lower beams separate from one another and ensure that both reach excellent as stated in the chart.

MONITOR JACK OUTPUT	ALIGNMENT LEVEL
5.5V Over	Excel
3.5V~5.5V	Good
2.5V~3.5V	Fair
1.0V~2.5V	Realign
1.0V Under	Poor

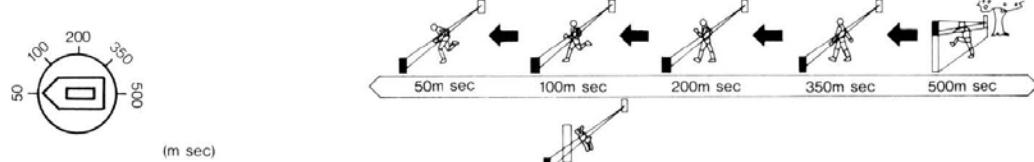
Optical Alignment for Indoor Use
Obtain maximum voltage from the monitor jack, at least **more than 3.4V**

Confirmation of Action

- Check that the operation indicator ("ALARM CONDITION" LED) light is OFF.
- If the indicator light is ON even though the beams are not blocked re-adjust the optical alignment and check wiring. (See Sec 5-3)
- After alignment is achieved and the units work properly, conduct a walk test at a minimum of three points.
- In front of the Transmitter.
- In front of the Receiver.
- At the middle point between Transmitter and Receiver.

6. BEAM INTERRUPTION TIME ADJUSTMENT

The beam interruption time adjustment is on Receiver unit. This function allows you to match the units sensitivity to its surroundings. Slower settings reduce sensitivity.



CAUTION:

- Speeds shown above are the maximum detectable speeds for each setting. Faster speeds will not be detected. Where birds, newspapers or flying debris can occasionally interrupt the beam, adjust setting to a slower speed (longer interruption period.)
- Beam interruption times exceeding 70 msec do not comply with the requirements in UL639. Intrusion Detection Units.

7. AX-350 / 650MK II

7-1. SELECTABLE BEAM FREQUENCIES

BEAM FREQUENCY
SELECT SWITCH

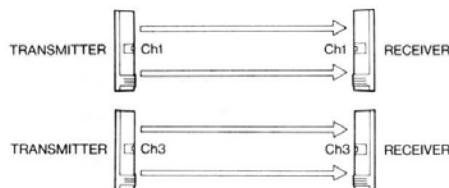


The selectable beam frequencies can be used to avoid unwanted crosstalk that can occur when using multiple photobeams for long distance or beam stacking applications.

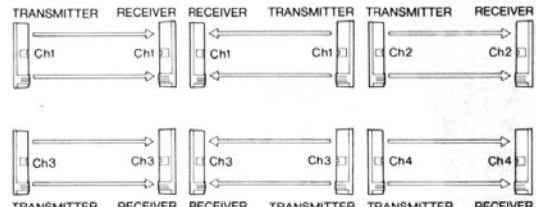
- To select between 4 separate beam frequencies, use the switch provided.

IMPORTANT Always switch the frequencies TWO channels apart when stacking units on top of one another (See following example). The upper unit is set on channel 1 while the lower is on channel 3, channel 2 and 4 could have also been used.

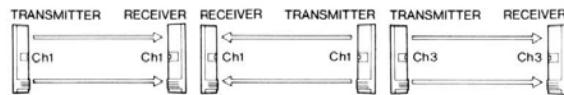
1 2 beam stacking



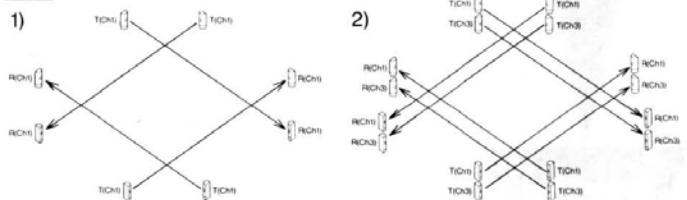
3 2 beam long distance stacking



2 Long distance



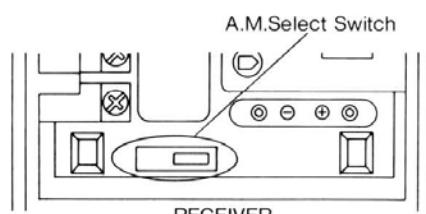
4 Perimeter protection



7-2. ALARM MEMORY

1. Wiring

Connect control voltage signal terminal (System arming status voltage output terminal) of control panel to A.M.terminal.



Model	AX-350MK II, AX-650MK II	
Type	NEGATIVE	POSITIVE
A.M. Select Switch Position		
System armed	0~1VDC(grounded)	OPEN or + 5~30VDC
System disarmed	OPEN or + 5~30VDC	0~1VDC(grounded)

2. Operation of Alarm Memory

- If the units is triggered during an armed period, when the system is disarmed, its LED will remain lit to confirm that it reported the alarm.
- Alarm Memory will not latch while system is disarmed.
- LED operation and alarm output are not affected by alarm memory when system is armed.

3. Reset

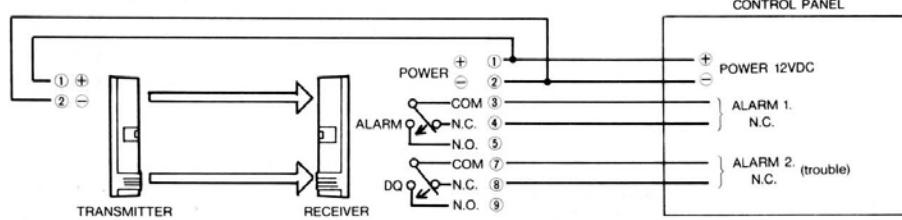
- Alarm memory resets automatically when system is re-armed.
- Optical, compatible control panel required.

7-3. DQ CIRCUIT(ENVIRONMENTAL DISQUALIFICATION)

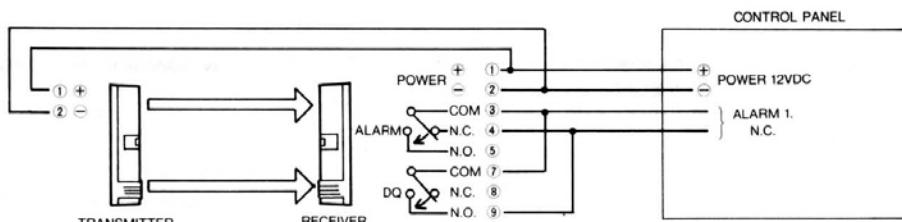
D.Q. will send a trouble signal when the beam strength is below an acceptable level due to heavy fog, rain, snow or other changes in the installation site. The trouble signal output continues as long as the beam strength is below an acceptable level. It will reset when the environmental conditions clear.

EXAMPLE

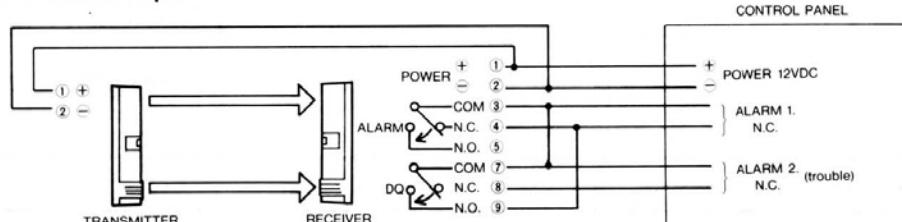
A. Trouble Output + Alarm Output



B. Bypasses Alarm

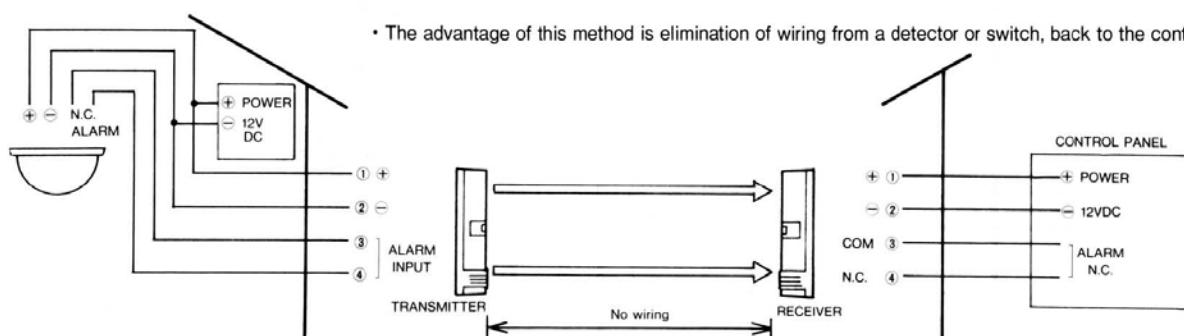


C. Bypasses Alarm + Trouble Output

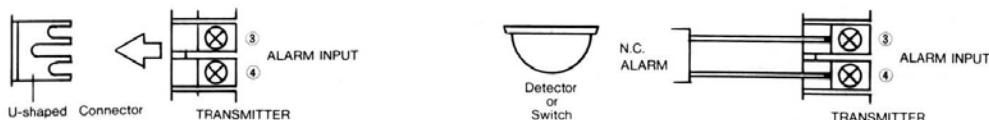


NOTE : If the control panel's input terminals have the same common, the alarm output, sleep and trouble output can be triggered simultaneously.

7-4. Re-Transmitting Circuit



• Remove the jumper (U shaped connector) from the transmitter's alarm input terminals (③ & ④) and connect the N.C. output of the detector or switch.



*** CAUTION ***

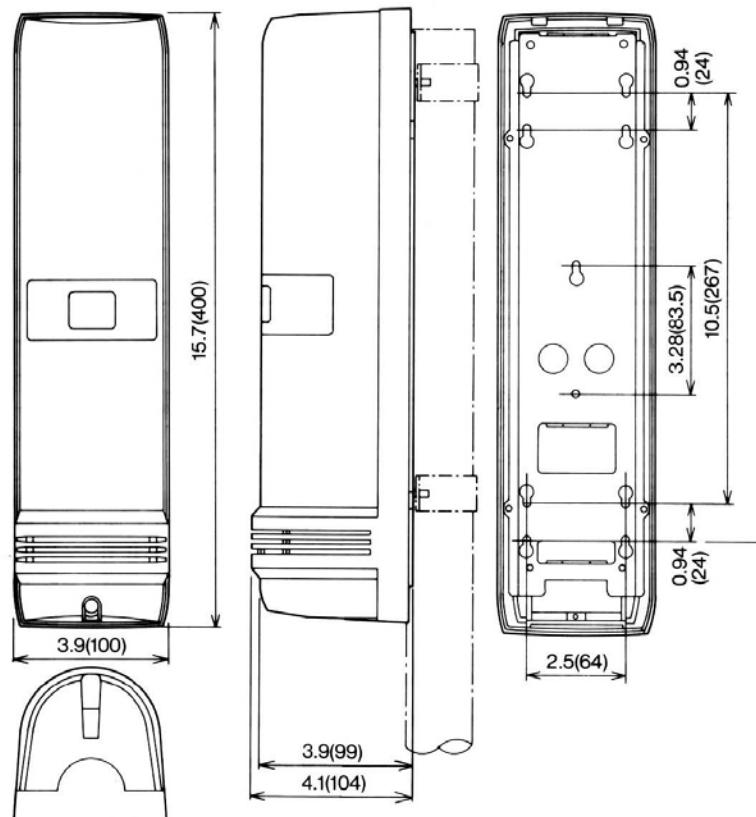
- Make sure you connect the jumper (U shaped connector) when the retransmitting circuit is not in use.
- Output of the detector or switch must be N.C.(N.O. is not acceptable.)

8. SPECIFICATIONS

MODEL	AX-250PLUS	AX-500PLUS	AX-350MK II	AX-650MK II		
Detection Method	Infrared Photoelectric					
Range	Outdoor 250ft(75m)	500ft(150m)	350ft(100m)	650ft(200m)		
	Indoor 500ft(150m)	1000ft(300m)	700ft(200m)	1300ft(400m)		
Maximum Arrival Distance	2500ft(750m)	5000ft(1500m)	3500ft(1000m)	6500ft(2000m)		
Beam Characteristics	Pulsed Infrared					
Selectable Beam Frequency	4 channel (Automatic Synchronization)					
Interruption Period	50~500 msec>Selectable)					
Power Input	10.5~30VDC					
Current Draw (transmitter + receiver)	Normal operation 50 mA max		Normal operation 75mA max			
			During optical alignment 145mA max			
Alarm Period	2sec(± 1) nominal					
Alarm Output	Form C Relay (28VDC 0.2A max)					
Tamper Switch	N.C. opens when cover is removed (RECEIVER only)		N.C.opens when cover is removed			
Operating Temperature	-13°F ~131°F (-25°C ~ +55°C)					
Environment Humidity	95% max					
Alignment Angle	±10° Vertical, ±90° Horizontal					
Alarm Memory						
Environmental Disqualification Circuit	Form C relay operates when beam energy has been gradually reduced to abnormal level.					
Mounting	Wall or Pole					
Weight	95.2 oz(2700g)Transmitter and Receiver		98.8 oz(2800g)Transmitter and Receiver			

* Specifications and design are subject to change without prior notice.

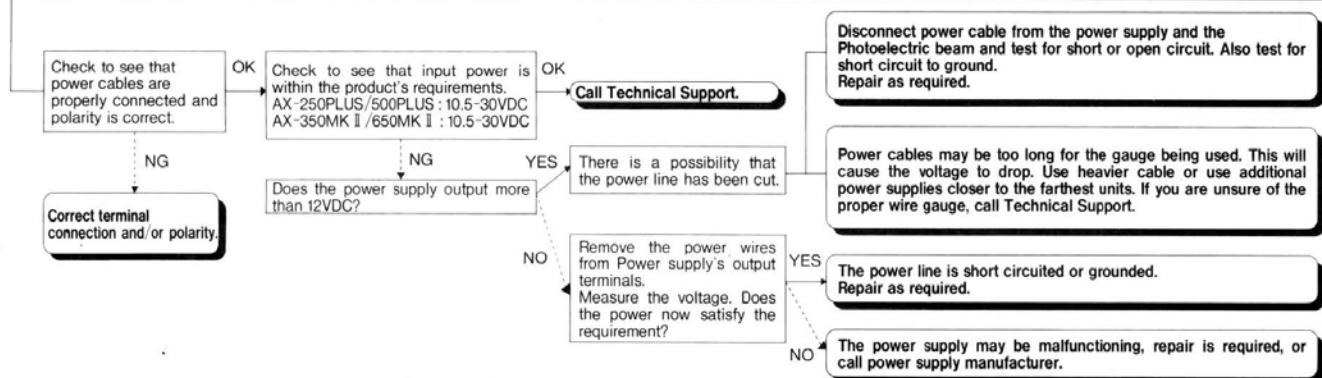
9. DIMENSIONS



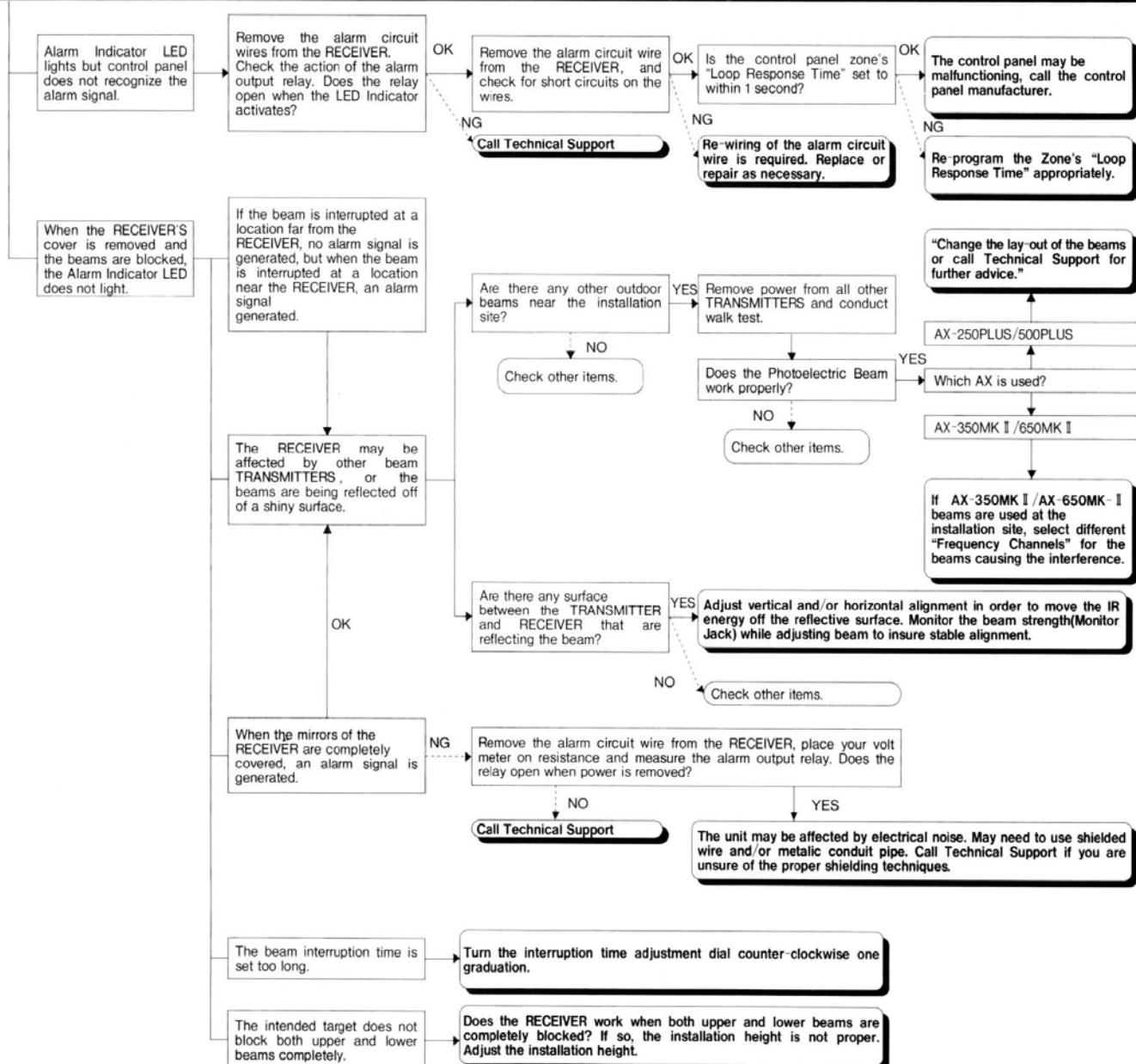
Dimensions : inches(mm)

10. Trouble Shooting Check Sheet for AX-250PLUS/500PLUS/350MK II /650MK II

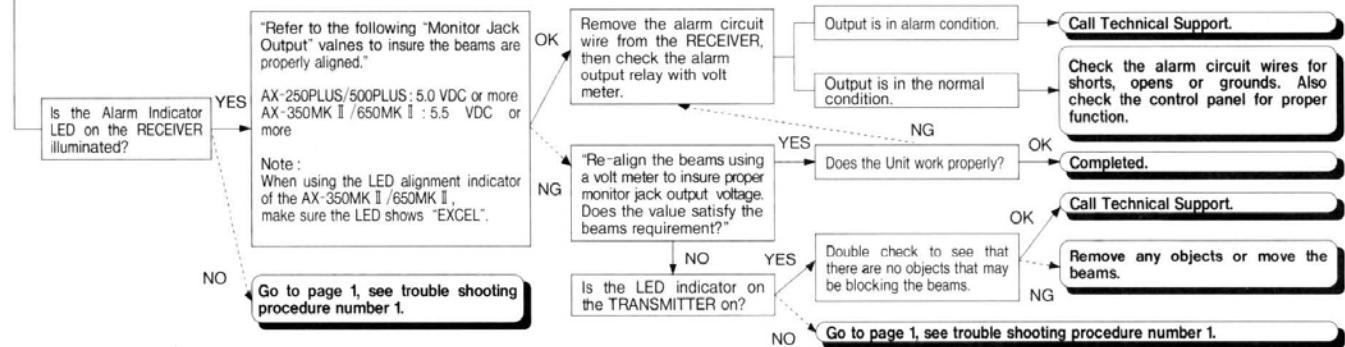
1. "No Action" on the TRANSMITTER or RECEIVER after power has been applied.



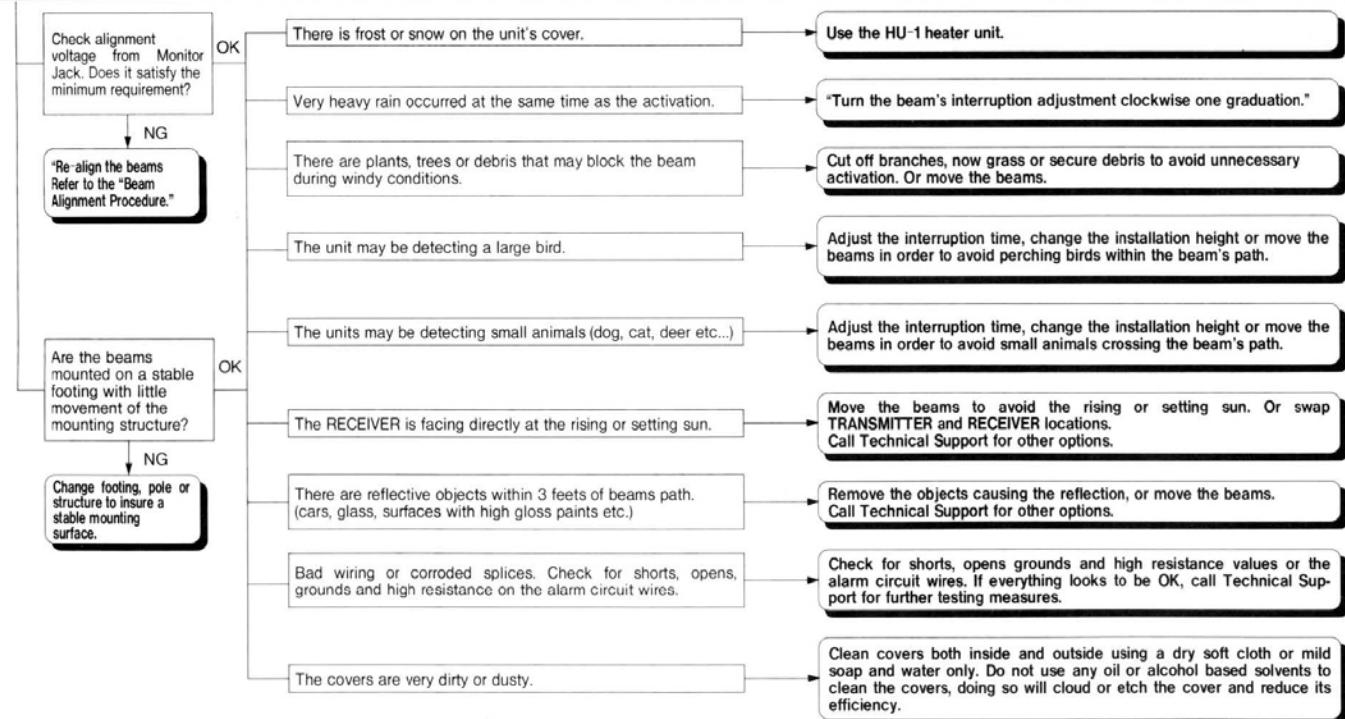
2. "No Action" on alarm zone even though the beams are completely blocked.



3. Alarm signal is being generated though beams are not blocked



4. False activations



Note : Beam Alignment Procedure

When aligning dual or twin beams you must cover both bottom receiver mirror and transmitter mirror with blocking shields, than adjust the top attempting to maximize the Monitor Jack Voltage(see below). When maximum voltage is obtained, place the blocking shields on both upper receiver mirror and transmitter mirror and adjust lower for maximum Monitor Jack Voltage.(Do not align both beams simultaneously.)

AX-250PLUS/500PLUS : 5.0VDC or more
AX-350MK II/650MK II : 5.5VDC or more
When using LED INDICATOR of AX-350MK II/650MK II, align to get at least "EXCEL".

Important :

The majority of false activations can be attributed to poor beam alignment. When aligning outdoor beams accept no less than an "EXCEL" value for the most stable and trouble free system!! Refer to the installation manual for acceptable Monitor Jack Voltage Values.



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